

The Minimum Lethal Dose of Fluoride

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accidents

The minimum dose of fluoride that can kill a human being is currently estimated to be 5 mg/kg (5 milligrams of fluoride for each kilogram of body weight). This dose is referred to in the medical literature as the “Probable Toxic Dose” or “PTD.” The dose is sufficient to cause severe poisoning, and in the absence of medical treatment, can be lethal. As noted by Dr. Gary Whitford, the PTD is the “minimum dose that could cause toxic signs and symptoms, *including death*, and that should trigger immediate therapeutic intervention and hospitalization.” (Whitford 1987). According to Whitford:

“This does not imply that this dose *must* result in death nor that a somewhat smaller dose would be innocuous. It does mean that even if it is only *suspected* that 5 mg F/kg has been ingested, it should be assumed that an emergency exists and that immediate treatment and hospitalization are required.” (emphasis in original).

SOURCE: Whitford GM. (1990). The physiological and toxicological characteristics of fluoride. *Journal of Dental Research* 69(Spec Issue):539-49.

Whitford has described the sequence of acute fluoride poisoning as follows:

“When sufficiently large amounts of fluoride are ingested as a single dose, a catastrophic chain of events rapidly develops. The first effects experienced by the victim usually include nausea, vomiting, and burning or cramp-like abdominal pains. There may be excessive salivation and tearing, mucous discharges from the nose and mouth, a generalized weakness, paralysis of the muscles of swallowing, carpo-pedal spasms or spasm of the extremities, tetany, and generalized convulsions. The pulse may be thready or not detectable. Blood pressure often falls to dangerously low levels at some point during the course of the toxic episode. As respiration is depressed, a respiratory acidosis develops. Plasma potassium levels are elevated, indicating a generalized toxic effect on cell membrane function. Cardiac arrhythmias may develop in association with the hyperkalemia. Plasma calcium levels are typically depressed, sometimes to extraordinarily low values (5 mg% or less). Extreme disorientation or coma usually precedes death, which often occurs within the first few hours after the fluoride dose.”

SOURCE: Whitford GM. (1987). Fluoride in dental products: safety considerations. *Journal of Dental Research* 66: 1056-60.

The fact that 5 mg/kg is sufficient to cause fatality does not mean that doses lower than 5 mg/kg should be considered safe. Indeed, symptoms of acute fluoride toxicity (e.g., gastrointestinal pain, vomiting, diarrhea, headaches) can be produced at doses far below the doses that kill. In 1980, for example, Spoerke showed that nausea, vomiting, and diarrhea regularly occurred at dosages lower than 1 mg/kg. In 1982, Eichler showed that dosages lower than 0.5 mg/kg caused nausea, vomiting, and fatigue. In 1994, a study in the *New England Journal of Medicine* showed that dosages as low as 0.3 mg/kg caused nausea, vomiting, abdominal pain, diarrhea, and headache. (Gessner 1994). And, in 1997, Akiniwa discussed a range of studies where acute fluoride toxicity occurred at dosages as low as 0.1 mg/kg. Based on the current evidence, therefore, the minimum dosage that can induce symptoms of acute fluoride toxicity appears to be 0.1 to 0.3 mg/kg. [Read more.](#)

Toothpastes Contain Enough Fluoride to Kill a Child

The amount of fluoride in a tube of fluoride toothpaste is sufficient to kill a child. As noted by Whitford:

“The concentrations and quantities of fluoride in selected dental products are discussed in relation to the PTD. It is concluded that, as these products are currently packaged, most of them contain quantities of fluoride sufficient to exceed the PTD for young children.”

SOURCE: Whitford GM. (1987). Fluoride in dental products: safety considerations. *Journal of Dental Research* 66: 1056-60.

Most disturbing, however, is the fact that even *bubble-gum and fruit-flavored* toothpastes for *children* contain sufficient amounts of fluoride to kill a child. Indeed, as shown in the following table, an average-weighting 2-year-old child could die from ingesting just 40% of a “Colgate for Kids” bubble-gum flavored toothpaste.



Minimum Lethal Dose of Fluoride Contained in One Tube of “Colgate for Kids” Toothpaste			
Age of Child	Average Weight*	Dose of fluoride which could kill child	Percent of “Colgate for Kids” toothpaste which, if swallowed, could kill child**
2 years	~12 kg	60 mg	42% of tube
3 years	~15 kg	75 mg	53% of tube
4 years	~16 kg	80 mg	56% of tube
5 years	~ 18 kg	90 mg	63% of tube
6 years	~20 kg	100 mg	70% of tube
7 years	~22 kg	110 mg	77% of tube
8 years	~25 kg	125 mg	87% of tube
9 years	~28 kg	140 mg	98% of tube

FDA Mandates Poison Warning for All Fluoride Toothpastes

Due to the risk of severe poisoning posed by ingestion of fluoride toothpastes, the Food & Drug Administration now requires that all fluoride toothpastes sold in the United States carry the following poison warning:

“WARNING: Keep out of reach of children under 6 years of age. If you accidentally swallow more than used for brushing, seek professional help or contact a poison control center immediately.”

Reported Poisoning Incidents from Fluoride Toothpastes, Supplements, & Mouthrinses

As a result of the FDA's warning, there are now over 20,000 reports *each year* to Poison Control Centers in the United States due to excessive ingestion of fluoride toothpaste. As can be seen in comparing the following two tables, this represents a nearly 20-fold increase since the FDA mandated the inclusion of the poison control warning in 1997. Compare, for example, the data from the following two tables. The first table provides data on Poison Control reports in 2009 with data on Poison Control reports from 1989 to 1994 (before the FDA warning).

Reports to Poison Control Centers in U.S. Due to Excessive Ingestion of Fluoride Toothpastes Data from: Bronstein (2009, 2010) & Watson (2003)								
			# Treated in Emergency Room	Medical Outcome*				
Year	Product	# Reports		None	Minor	Moderate	Major	Death
2009	F Toothpaste	24,547	378	4,781	1,146	42	2	0
2008	F Toothpaste	23,468	383	4,395	1,119	43	1	0
2002	F Toothpaste	24,087	411	4,852	1,218	40	1	1
* Minor effect: Minimally bothersome signs or symptoms that generally resolved without residual disability or disfigurement (e.g. self-limiting gastrointestinal symptoms). Moderate effect: More pronounced or prolonged signs or symptoms, or more of a systemic nature than minor								

systems. While the symptoms are not life-threatening (e.g., disorientation or high fever that responds readily to treatment), some form of treatment is indicated. **Major effect:** Signs and symptoms that are life-threatening or result in significant residual disability or disfigurement. (Shulman 1997)

SOURCES:

Bronstein AC, et al. (2010). 2009 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 27th Annual Report. Clinical Toxicology 48:979-1178. Bronstein AC, et al. (2009). 2008 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 26th Annual Report. Clinical Toxicology 47:911-1084.

Watson WA, et al. (2003). 2002 Annual Report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. American Journal of Emergency Medicine 21:353-421.

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**Reports to Poison Control Centers in U.S.
Due to Excessive Ingestion of Fluoride Products (Pre-FDA Warning)**
Data from: Shulman (1997)

Year	Product	# Reports	# Treated in Emergency Room	Medical Outcome*				
				None	Minor	Moderate	Major	Death
1989	Toothpaste	1,392	101	464	371	15	0	0
	Mouthrinse	1,185	56	503	115	3	0	0
	Supplements	4,028	375	1,807	663	14	1	1
	Vitamins**	3,153	184	1,214	135	0	0	0
1990	Toothpaste	1,379	107	468	329	7	0	0
	Mouthrinse	1,299	64	511	109	2	0	0
	Supplements	4,437	338	1,950	653	10	0	0
	Vitamins**	2,938	135	949	0	0	0	0
1991	Toothpaste	1,623	120	497	403	15	0	0
	Mouthrinse	1,418	72	556	112	0	0	0
	Supplements	4,350	368	1,593	667	12	0	0
	Vitamins**	2,741	102	595	93	3	0	0
1992	Toothpaste	2,331	141	700	497	17	1	0
	Mouthrinse	1,338	52	545	92	1	0	0
	Supplements	4,171	340	1,579	624	12	0	0
	Vitamins**	2,949	122	883	111	1	0	0
1993	Toothpaste	2,507	143	725	571	21	0	0
	Mouthrinse	1,144	52	409	75	4	0	0
	Supplements	3,483	249	1,143	503	16	0	1
	Vitamins**	2,650	105	706	100	0	0	0
1994	Toothpaste	3,369	166	852	800	19	1	0

	Mouthrinse	1,220	40	409	79	3	0	0
	Supplements	3,544	240	1,224	489	22	1	0
	Vitamins**	2,493	86	663	111	0	0	0
* <i>Minor effect</i>: Minimally bothersome signs or symptoms that generally resolved without residual disability or disfigurement (e.g. self-limiting gastrointestinal symptoms). <i>Moderate effect</i>: More pronounced or prolonged signs or symptoms, or more of a systemic nature than minor systems. While the symptoms are not life-threatening (e.g., disorientation or high fever that responds readily to treatment), some form of treatment is indicated. <i>Major effect</i>: Signs and symptoms that are life-threatening or result in significant residual disability or disfigurement. ** With fluoride but without iron.								
SOURCE: Shulman JD, Wells LM. (1997). Acute fluoride toxicity from ingesting home-use dental products in children, birth to 6 years of age. Journal of Public Health Dentistry . 57: 150-8.								

Fluoride Poisoning from Other Fluoride Dental Products (Supplements, Mouthrinses, Gels)

As can be seen from the table above, there are thousands of calls to Poison Control Centers each year for other fluoride products besides toothpaste. Several children have died from excessive ingestion of **fluoride supplements** and **topical fluoride gels**. A typical container of fluoride supplements continues to contain enough tablets to produce the PTD in a young child. An average-weighting two year-old child, for example, would ingest the PTD by swallowing 60 1 mg/F tablets.

Number of Ingested Tablets that Could Kill: Fluoride Supplements		
Age of Child	Average Weight*	No. of 1 mg/F Tablets**
2 years	~12 kg	60 tablets
3 years	~15 kg	75 tablets
4 years	~16 kg	80 tablets
5 years	~ 18 kg	90 tablets
*Average weight data obtained here ** 1 mg fluoride tablets typically come in containers with either 30 or 90 tablets.		



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